

New Pressure Cell for In-Situ Hydriding/Dehydriding of a Sample at Moderate Temperatures

The Science

The search for alternative fuel has spurred interest in complexes with high hydrogen absorption-desorption capacities. Among these compounds complex metal hydrides such as Na/Li AlH_4 , NaBH_4 etc. have received much attention. More recently it was proposed that simple metal nitrides such as Lithium Nitride (Li_3N), with its 9 wt % recyclable hydrogen uptake, could be good candidates for reversible hydrogen storage. The hydriding and dehydriding process for most of these materials takes place at elevated temperature and moderate hydrogen pressure. In-situ neutron diffraction among other things can shed light on these processes because hydrogen can be substituted with deuterium which is a strong neutron scatterer. For neutron diffraction studies it is often desirable to use a null scatterer such as $\text{Ti}_{66\%}\text{-Zr}_{34\%}$ or vanadium as the sample holder to minimize Bragg scattering from the holder. However, these metals have high affinity for hydrogen especially at elevated temperature. The alloy Inconel 718 was chosen for the cell because it has good resistance to hydrogen embrittlement and can be operated at the required temperature and pressure range. The cell has also been designed so that it can be introduced in and out of a glove box with relative ease since most of the materials we are studying are air sensitive and have to be handled inside a glove box.

The Sample Environment

The cell is rated at 1500 psig at 500°C. The pressurizing hydrogen gas is supplied by the 1/8" Inconel tube on the top flange. The temperature is measured and controlled separately top and bottom by twin Eurotherm 900 Process Controllers and power supplies.



Acknowledgements

The science is that of Dr. Ashfia Huq, then a post-doc on the GPPD instrument, now a SNS Instrument Scientist. The Inconel cell was designed by Bob Kleb, an engineer STA with the IPNS, and fabricated in the ANL Central Shops. The assembly and mounting of the cell was devised by Rich Vitt and Jon Baldwin of the IPNS Prototype Shop. The whole experiment, in particular the dual temperature control, was arranged by Evan Maxey, GPPD Instrument SA.